Physics Flash
July 2011

INSIDE

Students welcomed at Physics All-Hands meeting

A welcome to the Division's summer students and a focus on safety and security were the main themes at the year's first Physics Division All-Hands Meeting held recently at the Louis Rosen Auditorium at the Los Alamos Neutron Science Center.

"Safety is always important at the Lab and in Physics," said Physics Division Leader Doug Fulton. "And this is an especially important time to focus on safety with summer students here."
About 52 students are working in the division this summer.

The meeting, which was delayed due to the Las Conchas fire, featured safety and security information, a Physics Division overview including recent scientific success stories, news on environmental sustainability activities, and a technical talk highlighting a recent project.

Division Electrical Safety Officer Jacqueline Mirabal (Subatomic Physics, P-25), spoke to the need for students and staff to know the division and group electrical safety officers. For that and more information, please see esc.lanl.gov.

Laboratory Ombudsman Kirk Christensen discussed the program, which provides a confidential and impartial alternative for assistance with informal complaint resolution, problem solving, and communication. Its anonymous help line is 667-9370.

Debora Hall and Angelica Gurule (Environmental Stewardship, ENV-ES) presented ways to get involved in the Laboratory's environmental activities, including the Student Sustainability Challenge. This series of events and activities encourages students to take an active role in contributing to the Laboratory's environmental responsibility, raises awareness of critical environmental issues, and inspires innovation and ingenuity for better and more sustainable science and technology.

Frank Merrill (Neutron Science and Technology, P-23) presented the first neutron image collected at the National Ignition Facility. For more information, please see the April issue of *Physics Flash* at www.lanl.gov/orgs/p/flash_files/flash.shtml.

The presentations were followed by a pizza and poster session highlighting research in Physics Division.

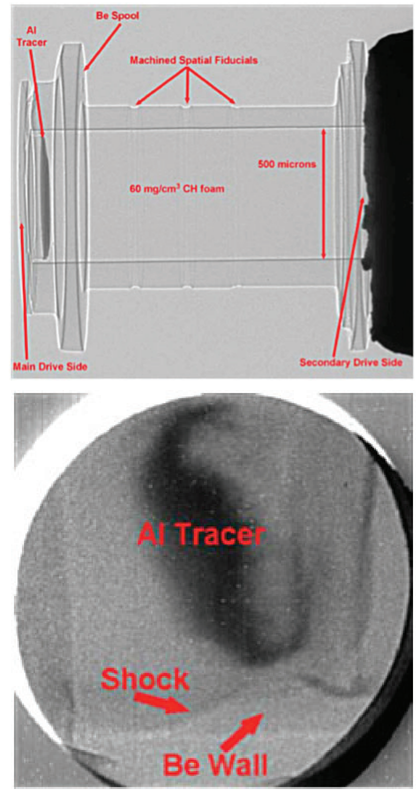
Los Alamos
NATIONAL LABORATORY

Understanding mix through laser-driven experiments

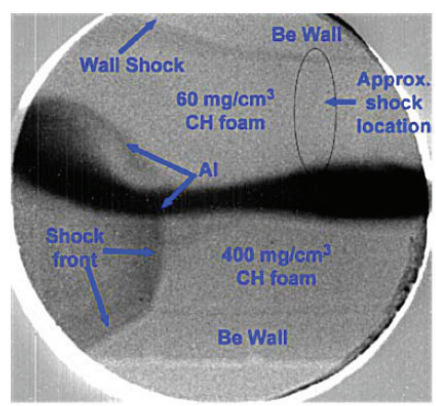
An understanding of mix is crucial for many applications. The Colliding Shock and the Shear campaigns are designed to provide data to understand the Lab's mix models. The colliding shock experiments study an interface layer that has been shocked to a turbulent state. The tracer layer is then subjected to a second strong shock. Data from the colliding shock experiment will be used to constrain one of the coefficients in the model. The shear experiment studies variable density shear layer mix. The data will be used to constrain a different coefficient in the mix model. Scientists conducted these experiments at the University of Rochester OMEGA laser facility. Target fabricators for the experiments include Deanna Capelli, Kim Defriend-Obrey, Derek Schmidt, Jim Williams, Gerald Rivera, Blaine Randolph, Frank Fierro, Bryan Bennett, Brian Patterson, and Chris Hamilton (Polymers and Coatings, MST-7).

Principal investigator Paul Keiter, Scott Evans, Eric Loomis, and Tom Sedillo (Plasma Physics, P-24); Jim Fincke and Leslie Welser Sherrill (Navy Systems, XTD-2); and Derek Schmidt (MST-7), contributed to the design and fielding of the experiments. Researchers fielded 13 shots. A preshot radiograph of a typical target is shown in the figure at top right. A shock is launched on the left-hand side. The shock interacts with an aluminum (Al) tracer layer, which evolves toward a turbulent state over the course of the experiment. A second shock is launched from the right-hand side, which propagates toward the Al layer. The hydrodynamic evolution of the system, including the evolution of the Al layer and the positions of the shocks in both the carbon hydrogen foam and the beryllium (Be) walls is measured. The figure (right, middle) depicts a radiograph of the hydrodynamic evolution of the system. The radiograph was taken at roughly 10.7 ns after the laser beams for the main drive fired. The Al tracer layer has evolved and differs from its original planar shape. A more detailed analysis will compare the data with the simulations. The campaign met all of the experimental goals. Data was obtained from two nearly orthogonal views from nominally 6.2 to 20.2 ns. This data are being used to confirm the preshot predictions and to indicate the simulations may not be predicting the experimentally measured results correctly.

The researchers dedicated a few shots for the shear campaign, which studies the turbulent nature of a tracer layer between two foams of the same composition but of differing density. The ability to perform a few physics experiments for this campaign enables scientists to compare to the preshot predictions and better prepare for upcoming experiments. The figure at right shows an example of the data from a shear target. The researchers measured shock positions and shapes in the high-density foam as well as the both Be walls.



(Top): A preshot radiograph of the Colliding Shock target. The main shock is launched from the left hand side, and 5 ns later the second shock is launched from the right hand side. Radiographs are obtained from two directions which measure the hydrodynamic evolution of the experiment at different times. (Bottom): A radiographic image of the hydrodynamic evolution at roughly 10.7 ns after the laser beams on the main shock side fired. The white crescent is an artifact created when convolving the data with a flat field image.



An x-ray radiograph, looking side on to a shear target. A shock front is clearly observed in the 400 mg/cm3 carbon hydrogn (CH) foam and also extending into the wall on that side of the target. A shock in the Be wall on the 60 mg/cm3 CH foam side is also observed. Based on the end of that shock as well as the compression in the Al tracer layer, the approximate position of the shock front in the 60 mg/cm3 foam can be inferred. Roll up of the Al layer is also observed. This radiograph was obtained roughly 8.61 ns after the laser drive was turned on.

continued on page 3

Laser . . . Campaign 10 (Steve Batha, LANL Program Manager) funds the colliding shock experiments, and Campaign 4 (Kim Scott, LANL Program Manager) funds the shear experiments. The work supports the Nuclear Deterrence and Energy Security mission areas and the Information Science and Technology and Materials for the Future capabilities.

Eric Brown elected to vice chair of TMS committee

Eric Brown (acting group leader of Neutron Science and Technology, P-23) was selected as the vice chair of the Content Development and Dissemination Committee (CDCC) for The Minerals, Metals and Materials Society (TMS). The vice chair serves as the chair of Strategy Subcommittee and acting chair of the CDDC in the absence of the chair.

Brown is particularly interested in the development of new and existing journals and databases to serve the community and society. As one of the TMS Administrative Board committees, the CCDC is charged with collaboratively guiding and supporting TMS initiatives and programs related to the development of content and its delivery via any form of media. The committee seeks to grow content-related revenue opportunities and to protect and build the TMS brand as a provider of content to the science and engineering community. Brown will serve as vice chair for three years.

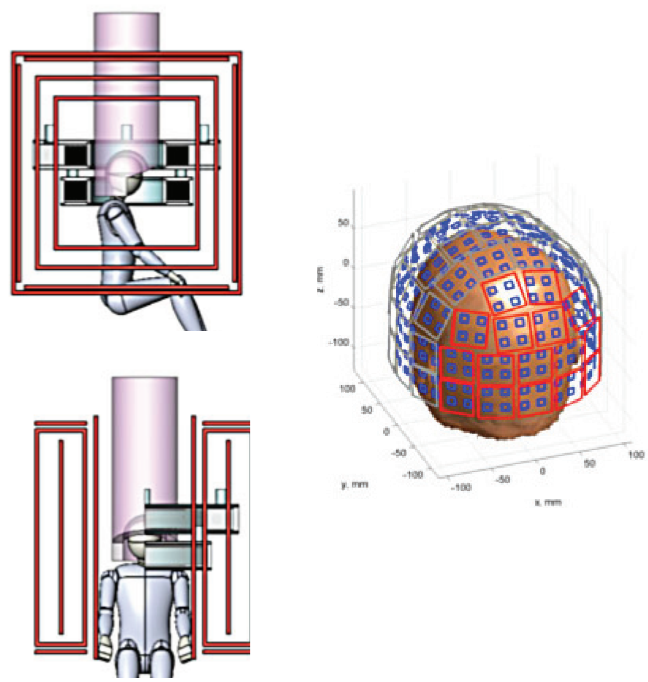
Brown, who was the recipient of a 2007 TMS Young Leader Professional Development Award in the Structural Materials division, is a key reader for Metallurgical and Materials Transactions A, associate technical editor for *Experimental Mechanics*, and has served as an invited guest editor for issues of *Experimental Mechanics* and the *International Journal of Plasticity*. While serving in the Office of the Secretary of Defense as the Technical Advisor for the Joint DoD/DOE Munitions Technology Program, Brown worked on development and implementation of data management and sharing systems addressing issues related to intellectual property, data impact, accessibility issues related to IT infrastructure, and documenting quality of information.

Advances in ULF and MRI technologies and applications

As part of the LDRD effort, the SQUID team is undertaking a number of efforts to enhance the utility and range of applications for ultra-low-field magnetic resonance imaging (ULF MRI). Because a principal limitation of the existing system is signal-to-noise ratio (SNR), a major effort is to increase the polarization field (Bp) strength by a factor of 3-6 times over their existing systems. A new liquid nitrogen cooled magnet has been designed and is under construction, which is intended to allow pulsed fields of 0.2-0.3 T. However, even with a new high power supply, the new magnet design cannot achieve the slew rates required for the rectangular polarization pulses used in previous work. In order to improve imaging speed and utility for MEG source localization a high density detector array is being developed.

Recent experimental work has demonstrated the feasibility of slow adiabatic ramps for MRI acquisition. Previous signal acquisition sequences have employed abrupt shifts in the measurement field to initiate spin precession. Alternatively, a time-varying field at the Larmour frequency will tip spins into the transverse plane initiating signal acquisition. Our experiments to date suggest that this approach may be less subject to phase dispersion due to inhomogeneities in the Bp field, and consequently can deliver significant enhancement in SNR.

A principal motivation for the development of ULF MRI is to pursue strategies to image correlates of neural activation that more closely track the characteristic timecourse of neural activation. Reports from other laboratories suggest that dynamic measurements of neural tissue conductivity may provide such a technique. Other investigators have employed surface electrodes for passing current and measuring induced potential, but this approach is rather insensitive to the properties of tissue within the highly resistive skull. Magnetic resonance allows local measurement of magnetic field throughout the tissue volume, providing an alternative strategy for tomography impedance measurements.



Designs for LDRD DR ULF-MRI coil system and MRI/MEG sensor array.

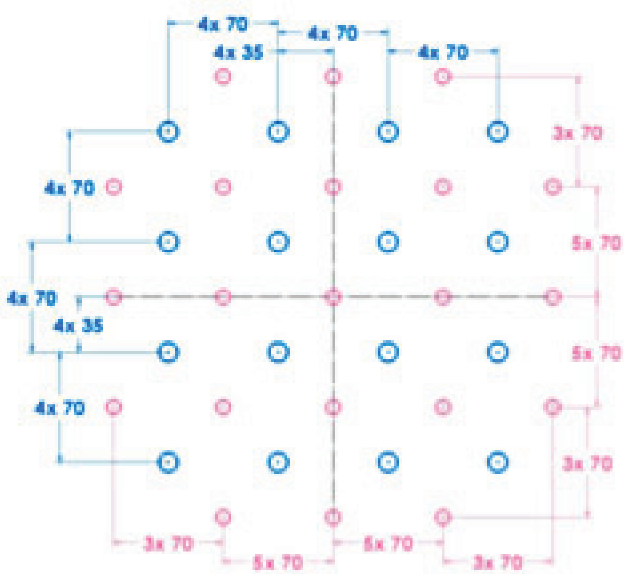
continued on page 4

ULF . . .The team has recently demonstrated two methods for tissue impedance measurement by MRI. The first employs DC currents to systematically perturb a phase map constructed from a standard imaging paradigm. The second uses time-varying current at the resonance frequency to tip the spins, so that image magnitude is proportional to conductivity. At high magnetic field and its high magnetic resonance frequencies, the induced currents are conducted primarily through cellular capacitance. At typical ULF measurement frequencies (e.g. 1-10 Hz) the applied currents probe physiologically relevant properties. Pilot studies using this approach have served as the basis of a recent NIH proposal as well as a patent disclosure.

Technical contact: Michelle Espy

First version 2 Pinhole Images

Recently, a team of physicists and technicians, led by Frank Merrill (Subatomic Physics, P-23) successfully collected neutron source images at the Omega laser, using the version 2 (v2), National Ignition Facility (NIF), neutron imaging pinhole. These images represent a significant milestone for the project. This pinhole was designed to provide higher resolution images, and to cover a larger effective field-of-view at the target plane, addressing pointing uncertainties in the NIF alignment system. The pointing tolerance at the NIF for individual pinholes is ~100 μrad, so by constructing an array of "mis-pointed" pinholes, the effective field-of-view may be increased. The pointing locations for the NIF v2 pinhole are illustrated in the figure below. Each pinhole points about 35 μm away from its nearest neighbor.

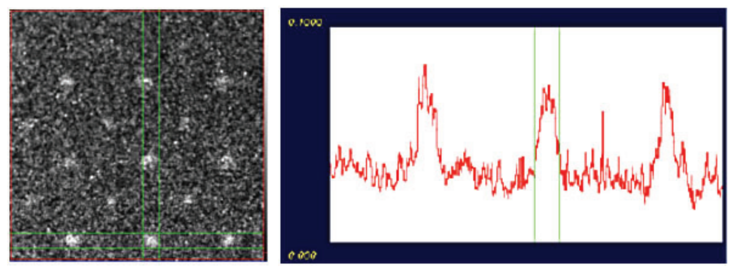


Pointing of the 37 NIF v2 pinholes at the target plane.

The next figure shows the front face of the NIF v2 pinhole, engineered by Valerie Fatherley (P-24) and fabricated by Derek Schmidt and Felix Garcia (MST-7). The dark squares on the gold background are the openings for each individual pinhole, and illustrate the fine work of P-24 and MST-7 colleagues.

Image of the NIF v2 pinholes at the end of the 20 cm long aperture body.

The figure below shows a sample of the data collected at the Omega laser in April.



Shot 61898 at Omega. Clear images of the individual pinholes are present, and the column averaged lineout shows their relative signal to noise.

The image on the left is from a direct drive implosion of a plastic capsule producing 2x10^{13} neutrons using the Omega lasers. Clearly present are images from both the small and large pinholes within the aperture array. Due to the size of the imaging fluor at Omega, not all the pinhole images would fit within the camera. The left panel shows the column averaged lineout within the green box drawn on image. From this data it is clear that the version 2 pinhole works as an imaging array, and given the yields at Omega, it is now time to bring this aperture to the NIF for further testing and use in imaging experiments.

In addition to this success, the Merrill-led team successfully fielded a new camera system that collected images from the start of the campaign. Further, the team also implemented late time modifications to the pinhole mounting hardware that significantly reduced uncertainties in the pinhole pointing. Source of funding for the research is NNSA Campaign 10 (Steve Batha, LANL Program Manager).

Technical contact: Gary Grim

LANL organizes international neuroscience workshop

Garrett Kenyon and John George (P-21) with Luis Bettencourt (Applied Mathematics and Plasma Physics, T-5) organized the Grand Challenges in Neural Computation II conference, held this spring at La Posada hotel in Santa Fe. This gathering of more than 100 participants was a follow-up to a highly successful "Grand Challenges" conference held at the same venue in 2008.

The workshop aimed to identify and define present opportunities and remaining obstacles that must be exploited or overcome in order to achieve a comprehensive, functional understanding of biological neural processing systems for synthetic cognition and biologically inspired computation.

The workshop brought together systems neuroscientists, theorists, scientists, and engineers to examine experimental and computational approaches to system neuroscience, advanced neuroimaging technologies and high-density neural interfaces, the development of models and algorithms that exhibit cognitive behavior, and the design of novel neuromimetic architectures and application systems. It will also include a discussion with interested sponsors and stakeholders of applied neuroscience's strategic potential. Speakers from Los Alamos included Michelle Espy (P-21), John George, and Steven Brumby (Space and Remote Sensing, ISR-2).

The workshop was co-sponsored by three Laboratory Directed Research and Development projects with a neuroscience focus, whose principal investigators (PI) and co-PIs include George, Kenyon, and Espy. The Center for Nonlinear Studies (CNLS) and Sandia National Laboratories also co-sponsored the workshop. The conference supports LANL's Integrating Information, Science, and Technology for Prediction capability pillar. More information: http://cnls.lanl.gov/neuralcomp2/.

Technical contacts: John George or Garrett Kenyon

Celebrating Service

Congratulations to the following Physics Division employees celebrating service anniversaries this month:

Robert Sedillo, P-21	15 years
Yvette Maes, P-21	15 years
Samuel Letzring, P-24	15 years

HeadsUP!

Resetting a 15A or 20A, 120V electrical circuit breaker

Many of the buildings we occupy originally were designed and built for other purposes and in some locations we've reached the maximum capacity of the available power. Also, older buildings typically have single pane windows and lack good insulation leading to the use of portable space heaters in the winter and window air conditioners in the summer. As a result, it's not uncommon that you turn something on and a circuit breaker trips. Less commonly, a circuit breaker may fail due to age or wear and tear. That's the reason the facilities have a circuit breaker maintenance program. In fact, in FY10 circuit breaker inspections at LANSCE found about 20% failed, and failed and aging breakers forced work stoppages at Sigma (SM-66).

If you know which panel in your facility contains the circuit breaker that tripped, can you reset the breaker? The answer, unsurprisingly, is it depends; but first some background information.

Effective March 1, 2011 revision 1 of the Electrical Safety procedure (P101-13) became effective. This was a fairly extensive rewrite of the procedure with additional information from the National Fire Protection Association (NFPA) 70E document, "Standard for Electrical Safety in the Workplace." Translated, this means (among other things) that P101-13 addresses the arc-flash hazard, and that in turn results in requirements for personal protective equipment (PPE) when resetting a circuit breaker. The minimal PPE for resetting either a 15 amp or 20 amp circuit breaker is a cotton lab coat with long sleeves, long pants made of non-melting or untreated natural fiber material e.g. blue jeans, hearing protection, leather gloves, and safety glasses. For the purpose of resetting a circuit breaker, never wear a lab coat or pants made of a synthetic material (e.g., nylon) because in the event of an arc flash it not only will not protect you; it could melt on you and make an already bad situation worse.

For the resetting process you get one (1) try. If you are a qualified electrical worker (ESO or energized electrical worker training) and you have a reasonable certainty as to why the circuit breaker tripped, you may proceed as follows:

1. Turn off or disconnect the source of the fault or overload. Prepare for resetting the circuit breaker by putting on the minimum required PPE.

Resetting . . .

2. Standing off to the side of the panel, open the panel door and locate the tripped circuit breaker.
3. Make sure the circuit breaker is in its tripped state and not switched OFF. If you find the circuit breaker switched OFF, someone has positioned it that way. Either you have identified the wrong circuit breaker or someone else got to it ahead of you and you need to find out more information from your facility/maintenance coordinator. Until you know, you're done for the time being, so close the panel door and go get some answers or help
4. If tripped, switch the circuit breaker to the OFF position. Then, switch the circuit breaker to the ON position.
5. a. If the circuit breaker stays ON you're done. Close the panel door. You can now remove the PPE.
   b. If the circuit breaker trips again, there's more to the electrical fault situation than you initially realized. In any case, you're done. Close the panel door and remove the PPE. Last, but not least, contact your facility/maintenance coordinator for assistance.
6. Regardless of whether your attempt to reset a circuit breaker was successful, inform your facility/maintenance coordinator about the trip event. Repeated tripping of a circuit breaker causes wear that can lead to failure of the circuit breaker and that can be a serious situation.

For more information about the arc-flash hazard and resetting a circuit breaker, see P101-13, Section 6.4.4, "Arc-Flash Hazards," and Section 6.4.11, "Other Precautions for Personnel Activities, paragraph A, Operating Circuit Breakers or Fused Switches."

(Top) Examining `flaming wreckage' at the poster session

(Bottom) Physics Division management provided free pizza for the staff at the poster session of the All-Hands Meeting.

Physics Flash

is published by the Experimental Physical Sciences Directorate.
To submit news items or for more information contact Karen Kippen, EPS Communications , 606-1822, or kkippen@lanl.gov.
LALP-11-014

Los Alamos NATIONAL LABORATORY EST. 1943

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by Los Alamos National Security, LLC, for the National Nuclear Security Administration of the U.S. Department of Energy under contract DE-AC52-06NA25396.
A U.S. Department of Energy Laboratory.